

#### Terms and Definitions

- 3D Model: A digital representation of a three-dimensional object.
- Auto-Play: A feature that automatically animates the 3D model.
- Auto-Rotate: A feature that continuously rotates the 3D model to provide a comprehensive view.
- Camera Controls: Controls that allow users to adjust the view of the 3D model manually.

# Mobile Application

## Introduction

Technology is developing so fast that it has changed everything in our lives. It changed the way we shop, more particularly, cloth shopping. Due to the increasing demand and interest in online shopping, customers expect an interactive, more personalized shopping experience. The traditional approach to trying on clothes in-store is at first tiring but also related to hygiene issues, sometimes connected with private exposure. We now introduce our innovative mobile application for a virtual fitting room (VFR) to address these challenges and enhance the overall shopping experience.

Our VFR mobile application utilizes augmented reality, artificial intelligence, and sophisticated image processing technologies to give users the most straightforward and most realistic experience of trying on virtual goods.

A user only needs to scan their body once in the store, and a 3D model of them is created, stored, and accessed through the mobile app. It allows users to try out their clothes digitally from the comfort of their homes, eliminating the need to go to a fitting room physically and decreasing the risk of theft and invasion of privacy.

The mobile application will be built on top of Android Studio and will be user-friendly, along with high security. It shall have various functionalities that shall make the experience for the user much better, such as size recommendations according to body measurements, detailed fabric and view fit, and history of past fittings. Third, the app will also be integrated with the store's inventory so that users can notice exactly what styles and sizes are available.

Besides the leverage in customer shopping experience, our VFR mobile application has poignant benefits for retailers. These are operational cost-reduction benefits by not having to build fitting rooms across all their stores and saving on extra staff, as well as improved customer satisfaction and loyalty since it offers a more convenient and personalized way of shopping.

Our overall VFR mobile application is something such that it would work out to be in the fashion retail industry, serving to integrate online and in-store shopping, setting a new customer experience benchmark.

# Background

## 3D Modeling in Mobile Apps

Over the past few years, 3D modeling in a mobile app has made extreme overhauls possible in many industries, ranging from gaming and entertainment to education and, arguably most visibly, retail. The importance of 3D models within mobile applications is that they offer immersive and interactive experiences that provide gigantic proportions of user interaction and satisfaction. For example, in the case of virtual fitting rooms, the 3D modeling provides an image of how clothes will look and fit on one's own body makes for a realistic and personalized shopping experience unmatched by traditional, flat 2D images.

3D designs in mobile apps are digital representations of particular objects or environments created to be interacted with by users in real time.

Advanced augmented reality, virtual reality, and artificial intelligence technologies combined help render models as realistic and detailed as they can be sweated, turned, and manipulated from every angle. Within retail, however, what 3D modeling does is offer the ability to commit to the best customer experience in addition to featuring retailers' products much better to the customers, hence translating into sales with customer loyalty.

## Existing Solutions

Comparing our VFR mobile application with other existing apps in the market, there are several key differences and advantages noted. Other solutions in the virtual fitting room space include apps such as Zara's AR app, H&M's Virtual Fitting Room, and various online retailers' virtual try-on features.

### 1. Zara's AR App:

Zara's application uses AR to throw garment projection onto virtual models, visible to the customers. But it does lack that touch of a personalized experience while making a 3D model of the user.

Our VFR application takes this to an altogether more personalized level: the ability to scan one's own body and build up a personal 3-D avatar to get a still more realistic view of how clothes will look on a person.

### 2. H&M's Virtual Fitting Room:

H&M's virtual dressing room allows customers to see what clothes would look like with the use of predetermined models. Although this has a certain level of interactivity, it can't really cope with the bulk of individual body types.

In sharp contrast, our app's body scanning feature will make sure that the virtual try-on is tailored to the individual shape and size of every single user's body type for fitting and perfect visualization.

### 3. Stores Online that Allow Virtual Try-On:

-There are those very fundamental virtual try-on techniques implemented by some online retailers that involve a 2D overlay on top of a user's photo. Most solutions like this lack the depth and realism of 3D models.

With advanced 3D modeling and the use of AR technology, though, our VFR app is very much closer to reality and allows customers to see what kind of garment draping they will finally achieve on their respective 3-D avatars.

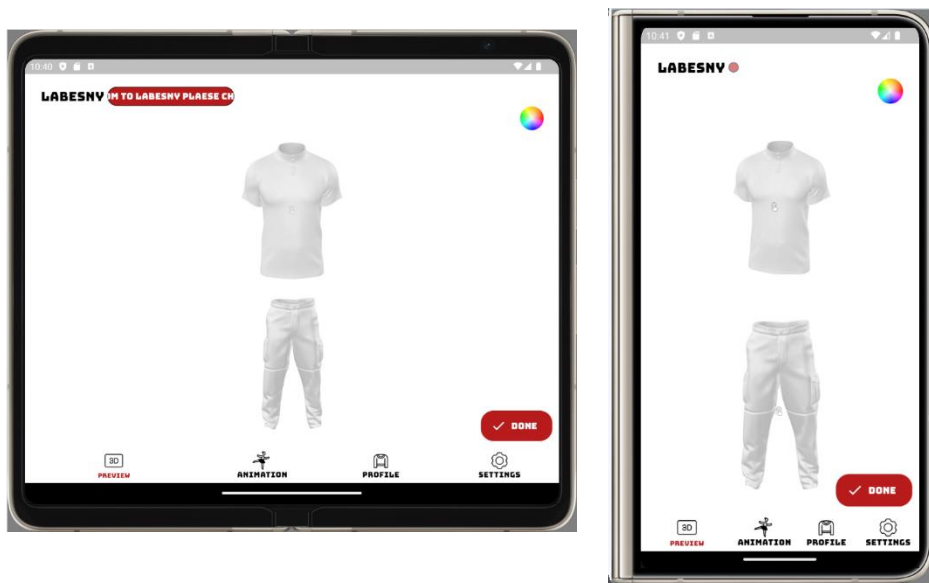
One of the most striking peculiarities of our model is that a user will see himself three-dimensionally in clothes. That is a personal touch, making it possible for a user to try out garments virtually and get a feel closest to reality about how they would really look. By providing a more personalized and accurate fitting experience, our app absorbs the shortcomings of previous solutions, thus raising the new standard in fashion retailing. App Description

## Overview

Labesny is a state-of-the-art mobile application that can take the user experience to the next level with advanced 3D modeling technology. With this advanced 3-D modeling technology, the app's users can interact with a very realistic 3D model of the human body in incredible detail, allowing an immersive and, thus, personalized experience. This proves especially useful in fashion retail, health and fitness, and even education due to its real-time visualization of and interaction with 3D models.

## Key Features

This Labesny application fits perfectly into any screen size for coherency and optimizes the user experience on several devices. It utilizes Flutter's responsive design, having its layout and different elements it changes dynamically owing to screen size and resolution. The flexibility is achieved by flexible layouts, which provide responsive columns and rows that extend or shrink accordingly with available screen space. Besides, the widget system of Flutter provisions for the development of



adaptive user interfaces targeted towards different screen orientations, the various ratios of

aspects, and pixel densities. Therefore, Labesny offers a clear, attractive, and intuitive experience while running on any device—a smartphone, tablet, or even a desktop computer.

Moreover, 3D Model Viewer The most vital feature of Labesny is the powerful 3D Model Viewer, which allows users to see high-quality and highly detailed 3D models of the human body. The advanced graphics and rendering techniques applied in this feature bring users closer to as accurate a view as possible that is interactive and exploratory. Be it a fashion enthusiast who wants to see how the clothes would fit, or for that matter, a student of the human anatomy, this 3D model viewer works smoothly. The Labesny application utilizes various types of connections to facilitate its operations. At first, it establishes a socket and FTP, File Transfer Protocol, connection between the app and the processing microcomputer from NVIDIA Jetson. This connection will help in sending data for 3D models and other details on processing and rendering to the microcomputer from the app. The socket connection will help allow real-time communication between the app and the microcomputer in terms of smoother interaction over the 3D models. Files, such as textures or animations, are transferred between the app and the microcomputer by an FTP connection. Another line of connection that allows communication between the app and a server to communicate is an HTTP—Hypertext Transfer Protocol—connection. Such a connection is used to download data to the application from the server, for example, user settings or apparel that help make the avatar more resembling a human figure. An HTTP connection would ensure that the app can access new changes, thus allowing users to receive current information and content. Below is a straightforward example of how the connections could be realized in the application:

The Socket connection:

```
void connect() async {  
    // Connect to the server  
    var socket = await Socket.connect('127.0.0.1', 5000);  
    print('Connected to the server');  
  
    // Listen for responses  
    socket.listen((List<int> data) {  
        print('Received from server: ${utf8.decode(data)}');  
    });  
    // Send a message  
    sendMessage(socket, 'Hello, Server!');  
}
```

```
// Function to send a message to the server.
void sendMessage(Socket socket, String message) {
    print('Sending message: $message');
    socket.write(message);
}
```

#### The FTP connection:

```
Future<void> download() async {
    final XFile? image = await picker.pickImage(source: ImageSource.gallery);
    FTPConnect ftpConnect =
        FTPConnect('192.168.1.113', port: 21, user: 'user', pass: '12345');
    File? fileToUpload = File(image!.path);
    await ftpConnect.connect();
    bool res = await ftpConnect.uploadFileWithRetry(fileToUpload, pRetryCount:
2);
    await ftpConnect.disconnect();
    print(res);
}
```

#### The HTTP connection:

```
void post() async {
    var url = Uri.parse('http://10.0.2.2:5000/signup');
    var _headers = {
        'Content-Type': 'application/json',
    };

    var response = await client.post(url,
        headers: _headers,
        body: jsonEncode({
            "firstName": FUsername,
            "lastName": LUsername,
            "username": UserEmail,
            "password": UserPassword,
            "date_of_birth": selectedAge,
            'gender': selectedGender,
            'phone_no': Phonee,
        }));
    var jsonResponse =
```

```

        convert.jsonDecode(response.body) as Map<String, dynamic>;
token = jsonResponse["token:"];
//await storage.write(key: "token", value: token);
print('TOKEN SAVED');
// print(jsonResponse["token"]);
print(token);
print(1);
print('Response body: ${response.body}');

if (response.statusCode == 201) {
  Navigator.push(
    context,
    MaterialPageRoute(
      builder: (BuildContext context) => MainPage(),
    ));
  print("OKKKK");
} else {
  print('Response status: ${response.statusCode}');
  Navigator.pop(context);

  var jsonResponse =
    convert.jsonDecode(response.body) as Map<String, dynamic>;
  print(jsonResponse['error']); //throw exception and catch it in UI
  setState(() {
    data = jsonResponse['error'];
  });
}
}

```

## Interactive Controls

Auto-play: Allow the model to animate by itself, creating a dynamic view for the 3D model. Users can see how the model moves and changes—which helps facilitate understanding and interaction.

- Auto Rotate: When set on, the 3D model is continuously rotating itself, giving every view possible to the user without any manual motion. The feature is quite helpful for a user wanting to view a model all around with minimum hassle.

Camera Controls: Labesny provides intuitive camera controls—zoom in, zoom out, pan, and rotate—manually to the model. Users can focus on specific details and observe the model according to their preference, hence highly customizing and interactivating the experience.

## Model Integration

### Adding Dependencies

To integrate the 3D model viewer into your Flutter app, you need to add the necessary dependencies in

```

dependencies:
  flutter:
    sdk: flutter
  form_builder_validators: ^10.0.1

```

```

flutter_localizations:
  sdk: flutter
intl: ^0.19.0
o3d: ^3.1.0
logger: ^2.0.2+1
cupertino_icons: ^1.0.2
http: ^1.2.1
image_picker: ^1.0.4
another_flutter_splash_screen:
^1.2.0
  smooth_page_indicator: ^1.1.0
  intl_phone_number_input: ^0.7.4
  convex_bottom_bar: ^3.2.0
  animated_bottom_navigation_bar:
^1.3.0
    flutter_form_builder: ^9.1.1
    getwidget: ^4.0.0
    email_validator: ^2.1.17
    flutter_secure_storage: ^9.0.0
    country_state_city_picker: ^1.2.8
    country_picker: ^2.0.24
    lordicon: ^1.0.3
    gif: ^2.2.0
    salomon_bottom_bar: ^3.3.2
    socket_io_client: ^2.0.3+1
    auto_size_text: ^3.0.0
    shared_preferences: ^2.2.3
    ftpconnect: ^2.0.5
    rive: ^0.13.7
    camera: ^0.11.0+1
    provider: ^6.1.2
    marquee: ^2.2.0
    google_ml_vision: ^0.0.8
    url_launcher: any
    typewritertext: ^3.0.6
    model_viewer_plus: ^1.7.0
    tutorial: ^1.0.9
    tutorial_coach_mark: ^1.2.11
    loading_animation_widget: ^1.2.1
dev_dependencies:
  flutter_test:
    sdk: flutter

```

## User Interface and Experience

### Design Principles

- Intuitive Navigation: Ensure that users can easily navigate through the app with minimal effort.

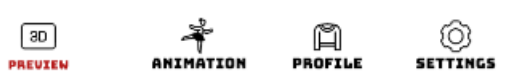


Figure 1:bottom Bar for navigation.

- Consistency: Maintain a consistent design language across all screens and interactions.



Figure 2:Simple direct buttons for interactions.

## User Interaction

Users can interact with the 3D models through touch gestures such as pinch-to-zoom, rotate, and pan. The interactive controls allow users to enable auto-play and auto-rotate features, enhancing the viewing. It also

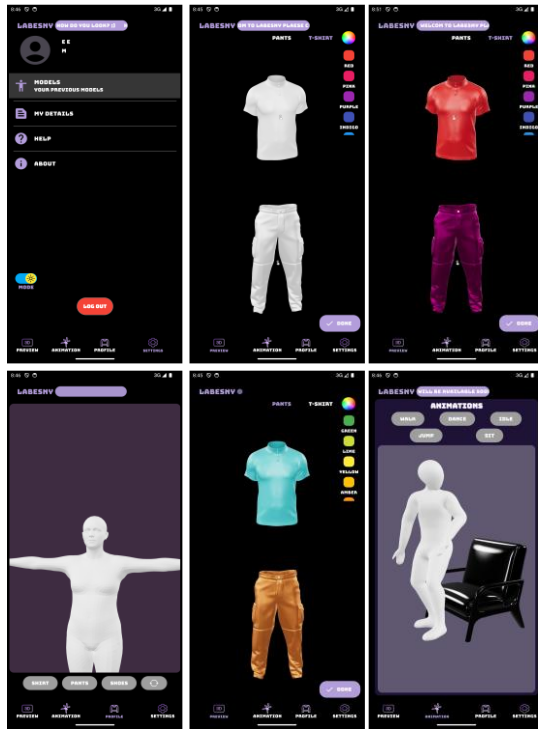


Figure 4:Dark Mode.

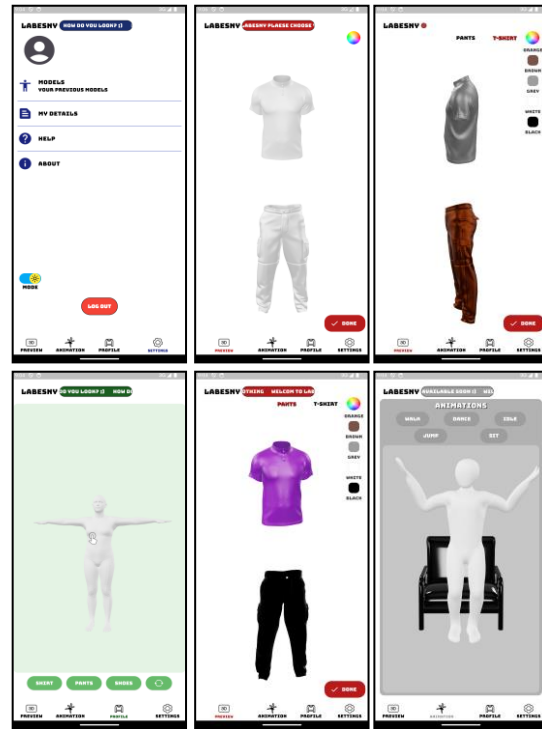


Figure 4:Light mode

offers multiple animations to the user for several poses or movements that can be done to see how the cloth fits and looks. This app also saves all user data, including body measurements and fitting sessions conducted earlier, for later reference and convenience.

## Testing Strategy

Unit Testing: Every interactive control should be tested—for example, auto-play and auto-rotate for the proper functioning of the camera controls. The 3D model should render correctly as well.

- Integration Testing: Check that the interactive controls work together without any conflicts.
- User Acceptance Testing: Involve users in testing the app's features and elicit their evaluations on the usability and performance of the application.

## Tools Used

- Flutter Test: Add unit tests that verify every interactive control supports the proper response to user input.
- Firebase Test Lab: This means running your app on many kinds of diverse devices to make it compatible and run well.
- Flutter Emulator.

## Test Cases

Model Loading: Ensure that the 3D model loads within an acceptable timeframe and it does ahead or appears appropriately.



- Interactive Controls: Test that each control (auto-play, auto-rotate, camera controls) functions as intended and is responsive to user input.
- User Interface: Whether the layout and other design elements are rendered consistently on all devices and screen sizes.

## Bug fixes

- Model Loading Issues: Ensure the proper referencing and loading of all model assets into the application. Correct any missing or wrongly loaded assets.
- Performance Optimisation: Render to avoid lagging or stuttering the 3D model in reaction to user interaction.
- UI Glitches: These entail visual inconsistencies in the user interface or layout issues that may impact user experience.

## Platform

Lablesny targets Android only.

### Deployment Process

1. Build the App/ For Android: `flutter build apk`.
2. Deploy: Publish the app on Google Play Store and Apple App Store.

## Planned Features

- Augmented Reality: Include features of AR for a better view. - Customize Options: Allow the user to change the 3D model into different outfits and accessories. - More Interactivity: Provide gesture-based controls and other forms of interaction. Summary Lablesny is a modern 3D model viewer which allows interaction and displays ultra-realistic 3D models for enhance user experience. Some functions that make this app useful in various applications are auto-play, auto-rotate, intuitive control of the camera, etc. Final Thoughts The development process at Lablesny has been fascinating, but at the same time, we are eager to make progressive improvements in apps based on user feedback and technological advancement.

## List of References

- Bertiche, H., Madadi, M., & Escalera, S. (2022). Neural Cloth Simulation. *ACM Transactions on Graphics*, 41(6). <https://doi.org/10.1145/3550454.3555491>
- Boonbrahm, P., Kaewrat, C., & Boonbrahm, S. (2015). Realistic Simulation in Virtual Fitting Room Using Physical Properties of Fabrics. *Procedia Computer Science*, 75, 12–16. <https://doi.org/10.1016/j.procs.2015.12.189>
- Cai Mengxiao. (2017, July 8). *Hidden camera found in H&M store's changing room*. [https://news.cgtn.com/news/3d416a4e3159444e/share\\_p.html](https://news.cgtn.com/news/3d416a4e3159444e/share_p.html)
- Daphne Howland. (2023, November 29). *Retailers have a crime problem*. <https://www.retaildive.com/news/retailers-crime-problem-numbers/699107/>
- Purwaningtyas, A., & Rahadi, R. A. (2021). THE AFFECTING FACTORS ON ONLINE CLOTHING PURCHASE: A CONCEPTUAL MODEL. *Advanced International Journal of Business, Entrepreneurship and SMEs*, 3(8), 86–97. <https://doi.org/10.35631/aijbes.38006>
- Siegmund, D., Samartzidis, T., Damer, N., Nouak, A., & Busch, C. (2014). Virtual Fitting Pipeline: Body Dimension Recognition, Cloth Modeling, and On-Body Simulation. *VRIPHYS 2014 - 11th Workshop on Virtual Reality Interactions and Physical Simulations*, 99–107. <https://doi.org/10.2312/vrphys.20141228>
- Traumann, A., Anbarjafari, G., & Escalera, S. (n.d.). *A New Retexturing Method for Virtual Fitting Room Using Kinect 2 Camera*.
- WPXI-TV, & Pete DeLuca. (2023, November 8). *Man accused of using hidden camera to record woman in Shadyside Gap dressing room*. <https://www.wpxi.com/news/local/man-accused-using-hidden-camera-record-woman-shadyside-gap-dressing-room/N653DY2Q4RCDFG5GBSLQQFGVQU/>
- <https://www.forbes.com/sites/forbestechcouncil/2021/09/16/virtual-dressing-rooms-a-guide-for-fashion-retailers/?sh=755d56d3b87e>